Practical Guide to Participatory Scenario Planning

Key concepts in climate services

Harvesting onions during the dry season in Tariganga, Ghana. Nicola Ward/ALP CARE International, 2013.

The concepts described in this guide have been defined in various publications and are in common use, especially in climate services, in the IPCC Reports and in disaster risk reduction (DRR). In this guide, the concepts are elaborated to improve understanding, interpretation and communication of seasonal climate forecasts, as is done using the PSP approach.

2.1 Introduction to climate services

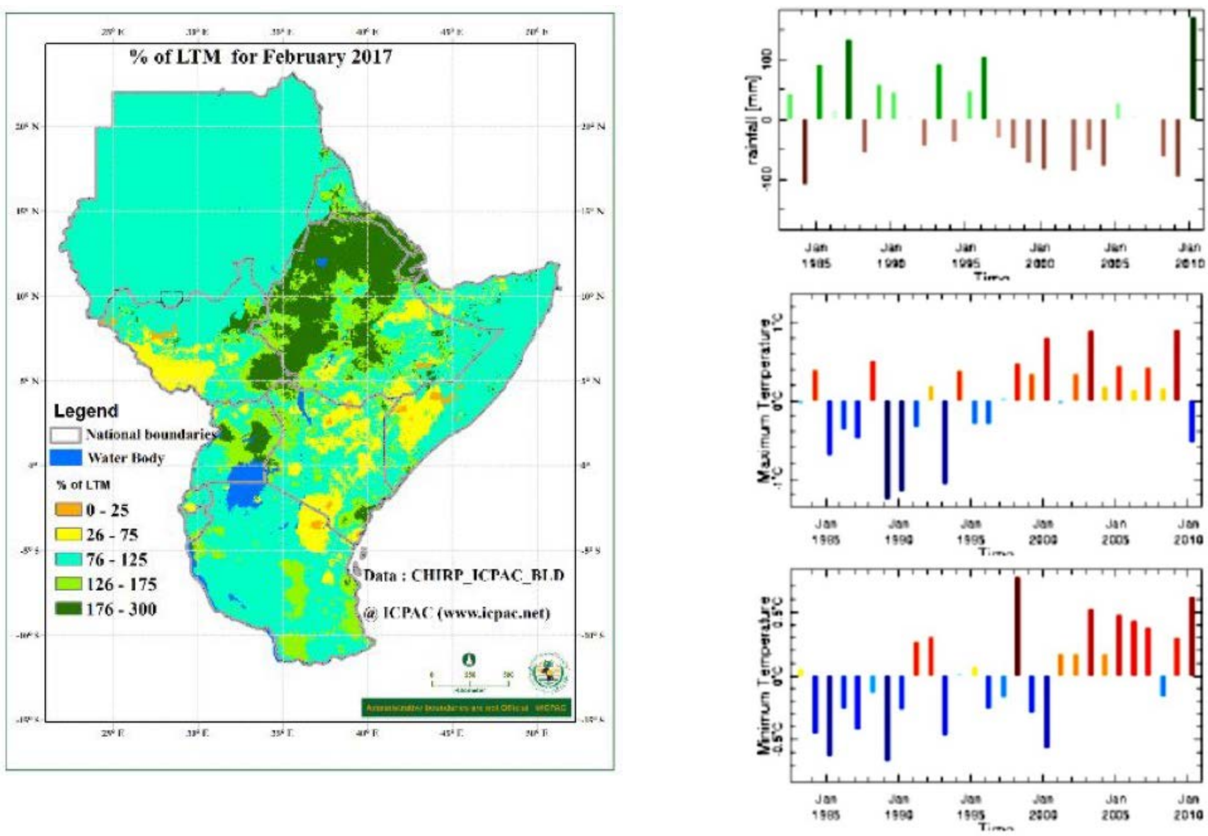
2.1.1 Climate information

Climate information is information about weather and climate conditions and events at past, present and future dates as well as the resulting implications for stakeholders' lives and livelihoods, development and the environment.

'Past' or 'historical' climate information from meteorologists (climate scientists) refers to data on weather elements collected using measurement instruments such as rain gauges, thermometers, barometers and satellites, among other instruments. The data is analysed to define different define weather and climate patterns and trends, for example monthly and yearly rainfall variations (see example in Figure 2b) or temperature trends and climatological summaries of all other weather elements. Past climate information from local sources is based on memories and experience of previous seasonal patterns and changes observed by different groups and communities. The combination of historical climate information from both meteorological and local sources helps us to understand past climate variability patterns and possible trends in climate variations. This analysis can identify trends in the frequency of extreme climate events (for example, trends in unusually high temperatures, droughts, heavy rainfall) and the influence of particular phenomenon such as El Niño on climate in specific areas (see Annex 1).

Figure 2: *a) Percentage of average rainfall for February 2017 (Source: ICPAC* http://www.icpac.net/*); b) Trend in rainfall (top) max T (middle) and min T (bottom) for the Belg rainy season (February-May) in Ethiopia (Source: ENACTS* http://iri.columbia.edu/resources/enacts/*)*

a) **b)**



‘Present’ climate information is data on weather elements – such as millimetres of rainfall – recorded in real time and short-term weather forecasts from one to ten days (see Table 1). It also includes monitoring of and alerts on climate-related hazards such as flooding and disease.

Table 1. Weekly weather forecast for Migori County, Kenya

	TUESDAY 9 MAY 2017	WEDNESDAY 10 MAY 2017	THURSDAY 11 MAY 2017	FRIDAY 12 MAY 2017	SATURDAY 13 MAY 2017	SUNDAY 14 MAY 2017	MONDAY 15 MAY 2017
Morning							
Afternoon							
Night							
Rainfall distribution							
Maximum temperature	29.4c	30.0c	28.3c	27.8c	27.2c	28.2c	28.9c
Minimum temperature	18.2c	18.3c	18.3c	18.9c	18.3c	18.3c	18.3c
Hazards	Green	Green	Green	Green	Green	Green	Green

Key to rainfall distribution symbols: rain likely to fall in few places (less than 33%), rain likely to fall in many places (33–67%), rain likely to fall in most places (more than 67%). Green – No weather-related hazards are expected.

Box 1

WHAT IS MEANT BY WEATHER, CLIMATE AND CLIMATE VARIABILITY?

Weather: This is the day-to-day state of atmospheric variables such as temperature, rainfall, wind, cloudiness and humidity in a given place. Weather is what is happening now, or is likely to happen tomorrow or in the very near future (i.e. from minutes to days ahead).

Climate: Loosely said, ‘Climate is what you expect and weather is what you get.’ Climate is the average weather in terms of the mean and its variability over a certain time-span and a certain area. It defines typical weather conditions for an area based on averages over at least 30 years. For example, northern Kenya is expected to be hot and dry in January and February but cold in June, July and August; however, there may be year-to-year deviations from this. Climate varies from place to place, depending on latitude, distance to the sea, vegetation, presence or absence of mountains or other geographical factors. Climate varies also in time – from season to season, year to year, decade to decade or on much longer timescales (Baede, Ahlonsou, Ding, & Schimel, 2001).

Climate variability: This refers to the deviation of a climatic variable, such as rainfall, from its long-term average (calculated using data covering at least 30 years) in a specific location.

‘Future’ climate information gives forecasts of the possible future state of the weather and climate from weeks, months or seasons ahead. Future climate information also includes projections of climate at one to ten years and of climate change at several years ahead (see IPCC Assessment Report Five (AR5): Atlas of Global and Regional Climate Projections (IPCC, 2013).

Future climate information also refers to local knowledge that forecasts from a season to a few years ahead, often at village or watershed level. Local forecasters use a range of observable environmental indicators – such as trees, wind patterns and the behaviour of animals – and make judgements based on tradition, experience and comparison of indicators with historical memory of climatic occurrences.

2.1.2 Sources of climate information, scientific and local

Scientific climate information is based on data that is generated using measuring instruments and analysed to develop information on the past, present and future climate. This information is produced by a range of institutions such as:

1. National Meteorological and Hydrological Services (NMHS)
2. Regional meteorological centres such as the IGAD Climate Prediction and Applications Centre (ICPAC) and the African Centre of Meteorological Applications for Development (ACMAD), as well as agro-meteorological centres such as the Agrometeorology, Hydrology and Meteorology (AGRHYMET) Regional Centre
3. Global climate monitoring centres such as the UK Met Office and International Research Institute for Climate and Society (IRI)
4. Agricultural research institutions in different countries such as the Kenya Agricultural and Livestock Research Organisation (KALRO) and the Savannah Agricultural Research Institute (SARI) in Ghana
5. Scientific research programmes such as the Coordinated Regional Downscaling Experiment (CORDEX) and the World Climate Research Programme (WCRP).

Some schools, colleges and large farms, such as those growing tea or coffee, also keep records of weather variables like rainfall. Different climate information products from meteorological services can be accessed through their websites, radio and television and through forums such as the Regional Climate Outlook Forums in Africa e.g. for the Greater Horn of Africa (GHACOF), Southern Africa (SARCOF) and West Africa (PRESAO); see details in Chapter 9. Users can also request specific information that may be available depending on the capacity of meteorological services.

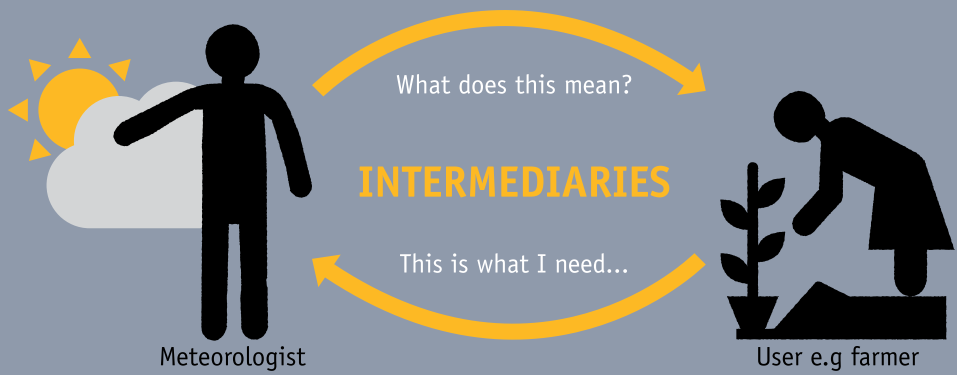
Local climate information is based on observation and monitoring, over long periods of time, of indicators such as plants, insects, animals and winds among other environmental indicators, as well as the movement of the sun, moon and stars. Observation and monitoring of these indicators, combined with experience and understanding of the relationship between these indicators and climate in a particular area, form a knowledge system used by local stakeholders to predict the weather and climate for a village or ward and in timescales ranging from a few hours, a season, to a few years in the future. The local climate observation and prediction system allow for a better understanding of an area's micro-climate and contributes to the body of knowledge on past and future climate in the local context. In addition, stakeholders of different ages, genders, social roles and responsibilities contribute different local knowledge and experiences of the impacts of climate management strategies. This local knowledge is often a combination of tradition passed from generation to generation (such as in local forecasting) and other sources of information – e.g. learning from formal/informal education, local stakeholders' farming and livestock keeping practices, TV/mass media, social media, travel to other areas, social and economic interaction, etc. Local climate information and knowledge leads to greater understanding of the environment by adding a local spatial scale and presenting information at a timescale closer to the present, while contributing to the body of knowledge on past and future climate in a local context.

2.1.3 Climate services

The term 'climate services', as used in this guide, refers to systems for generating, interpreting, communicating and using relevant weather and climate information and uncertainty, for climate-informed decision making and planning. In order to continually respond to diverse and changing needs for information, climate services require collaboration between, and sustained engagement of, stakeholders who produce climate information, intermediaries (see Box 2), and stakeholders who use the information. In particular, services must engage with users to understand their needs, to develop effective communication mechanisms, and to involve them in co-design and co-evaluation of information products and services (Tall, Hansen, Jay, Campbell, Kinyangi, & Aggarwal, 2014). Providing a climate service enhances risk management to reduce losses due to weather patterns and extreme climate events, and supports capitalising on opportunities for enhanced productivity and development.

Box 2
WHO ARE INTERMEDIARIES?

Intermediaries provide a link between all stakeholders involved in climate information services by facilitating two-way communication and dialogue for co-generation of downscaled information that is relevant and useful in the local context. Intermediaries in climate information services include government extension and research in agriculture and other climate-sensitive sectors, the private sector, community leaders, non-governmental organisations (NGOs), community-based organisations (CBOs) and the media, among others.



Intermediaries can enable the integration of climate information (from both local and scientific sources) with other information (e.g. soil types, socio-economics, vulnerability, capacity, risk, etc) so as to generate downscaled information that is relevant for local decision making. They work directly with decision makers and are therefore in a position to effectively communicate climate information and highlight information needs and demands. Intermediaries are essential in developing and supporting effective service delivery systems through participatory processes, information systems, building the capacity of different stakeholders, building trust, and advocating for resource flows and an enabling institutional framework for multi-stakeholder engagement in climate information services.

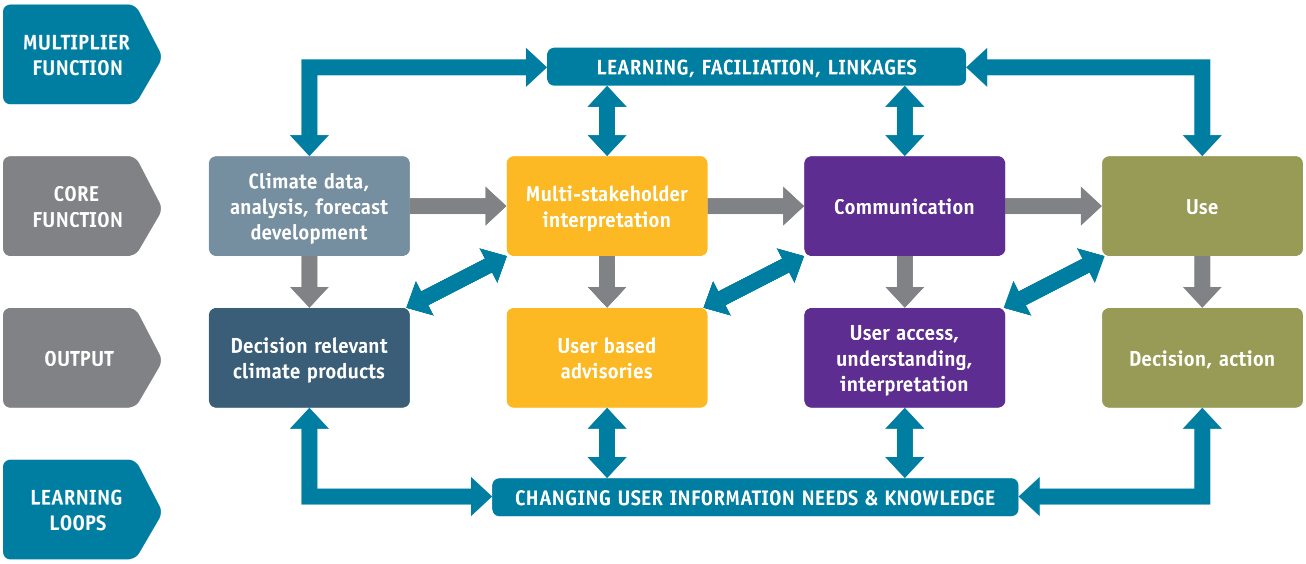
2.1.4 Role of knowledge brokering in climate information services

Sectoral services, especially in agriculture, and other intermediary actors such as NGOs, play a critical role in helping to develop and make available climate services that are responsive to diverse decision-making needs. They act primarily as intermediaries between the producers and the users of climate information – which mostly involves communicating information. This 'knowledge brokering' enhances the design and delivery of climate services better tailored to meet users' needs, and also facilitates and maintains links between actors at different levels and the various roles they play (see Figure 3). Climate knowledge brokering is essentially a multiplier function in the value chain, which involves facilitating:

1. **Multi-stakeholder engagement and dialogue platforms**, enable stakeholders to share, filter, integrate and interpret information from producers, intermediaries and users across different disciplines, sectors and levels to co-produce information relevant to the decision-making context (Bauer & Smith, 2015) – for example, by integrating information on climate, water and agricultural technologies and practices to co-produce information on climate resilient strategies. Such links also facilitate dialogue on provision of services that support the implementation of the strategies – for example, connecting input suppliers with farmers to meet the demand for particular crops or livestock that are best suited to future climate conditions.
2. **Two-way communication, feedback and learning loops**, can be facilitated by sectoral services, especially in agriculture. As they work with stakeholders from household to national level, sectoral services can interact with various users to understand how they access and use climate information, and therefore can highlight changing information needs and knowledge. Connecting user needs to effort spent producing the information will enable the development of tailored climate information products. This then feeds back to facilitating communication, understanding and building trust in the climate information produced to inform decision making and action.

Institutional frameworks and resource flows, create connections between existing institutions to enable integration of climate services into mainstream sectoral planning processes. This can strengthen collaboration to deliver user-based climate services, as well as to inform strategies for adaptation and climate resilience in various sectors.

Figure 3: *A knowledge value chain for co-developing and co-delivering user based climate services*



2.2 Key factors in delivery of climate services

2.2.1 Uncertainty

Uncertainty refers to a state of incomplete knowledge about the future state of the climate that can result from a lack of information or from disagreement about what is known or even knowable. Uncertainty may have many types of causes, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain states of future human behaviour that affect the climate (IPCC, 2013).

Although characterisation of uncertainty may be scientifically workable, for example by giving probability in a forecast, reducing uncertainty in climate depends on further progress in understanding the underpinning climate science. Hawkins & Sutton, 2009; Wilby & Dessai, 2010; and Osbahr & Viner, 2006, argue that climate science may only be partially successful in reducing these uncertainties in the next ten years. Their recommendation is that efforts should be directed to improving the communication of uncertainty, and how uncertainty can be better addressed in the future without causing decision paralysis.

2.2.2 Probability

Probability refers to the chance or likelihood that a particular climate event or condition will occur in the future – for example, a 40% chance of a drier than average (or normal) season in the following year.

Seasonal forecasts produced by meteorological services are usually presented in the form of probability of future climate values (e.g. rainfall) falling within three terciles. Each tercile contains an equal number of values that have been recorded over a 30-year period (see Table 2). The hypothesis used is that if the past climate in a specific location was to repeat itself exactly, then the probability that future climate values would fall in any of the three terciles is one-third, or 33.3%. This means that if the situation could be rerun many times, each outcome would occur one out of three times.

Table 2. An example of historical rainfall values that have been grouped to form a tercile

ABOVE NORMAL RAINFALL		NORMAL RAINFALL		BELOW NORMAL RAINFALL	
Year	Rainfall total	Year	Rainfall total	Year	Rainfall total
1985	1,217.43	1995	873.12	2000	498.93
1996	1,156.71	1982	824.17	1993	428.92
2002	1,097.28	2009	758.53	1999	339.46
2007	1,074.82	1997	754.22	2005	258.93
1988	1,055.64	1981	699.35	2010	209.96
1984	1,037.83	1989	686.40	2008	189.78
1994	1,025.94	1991	641.24	2006	152.02
1987	959.08	2001	630.90	1986	130.97
1998	940.87	1992	590.87	1983	116.27
2003	903.87	2004	532.89	1990	110.86

Probabilities of the different terciles provide the direction of the forecast relative to the average from long-term observations as well as the uncertainty of the forecast. For example, suppose a forecast shows rainfall probabilities of 20% 'below normal', 35% 'near normal' and 45% 'above normal'. Since the 'above normal' tercile is more than 33.3% and the 'below normal' tercile is less than 33.3%, this forecast suggests that 'above normal' rainfall is more likely and 'below normal' rainfall is less likely than has been historically observed.

A potential pitfall in interpreting such a probabilistic forecast is that most attention will be given to the tercile with highest probability, yet there is much uncertainty implied in the forecast. Even though the forecast is in the direction of 'above normal' rainfall, the probability of 'below normal' rainfall is still 20%, implying that in one out of five cases of this climate situation 'below normal' rainfall would be expected (definition adapted from the IRI).

The use of terciles in presenting a forecast is therefore an attempt to break down climate uncertainty into discrete possible future outcomes, to which probabilities can be assigned. This is because uncertainty in climate makes forecasting of exact values (e.g. exactly 17°C temperature or 450mm of rainfall) difficult as large errors are often likely. Errors in forecasting are, however, smaller than errors that would result from random guessing or from always forecasting the long-term average climate.

2.2.3 Scenarios

A scenario is a plausible, and often simplified, representation of future conditions or states of being, resulting from a well-worked answer to the question: 'What can conceivably happen in the future (e.g. due to forecasted climate in a season)?'

Asking that question recognises that the further ahead into the future we look, the more complex the climate system and its interaction with socio-economics, livelihoods, agriculture, and other climate-sensitive sectors become, meaning that uncertainty about the future increases. Scenarios, therefore, are a powerful planning tools that help to uncover and explore future uncertainties (in different aspects of life) in order to identify potential risks and opportunities (Lindgren & Bandhold, 2003). Scenarios make risk-management possible by prompting interpretation of a probabilistic seasonal forecast into information that is useful for strategic planning, with consideration of all possible seasonal climate futures and the resulting implications. They help in preparing for not one but many possible futures, which prompts diversification and risk spreading, combination of strategies, and building flexibility into planning to manage climate risks and opportunities in a season.

2.2.4 Downscaling

Downscaling refers to transforming information that covers a large geographical scale (e.g. a region such as the Greater Horn of Africa or an entire country) into local information (e.g. to cover a district, watershed or village). The transformation aims to capture local effects, like topography, that affect climate in a specific geographical area, so as to provide more detailed information for that locality.

Downscaling of climate forecasts is important, as actors need climate information that is relevant to the geographical scales for which decisions are to be made: for example, a river basin, an agro-climatic zone, a particular farm, etc. Presenting local climate information is critical, especially in Africa, because of large variability in climate over short distances (see case study 2). In addition, vulnerability and exposure to particular hazards (with implications for risk levels) are often location-specific: for example, poor agro-pastoralist households living next to a riverbank would be more vulnerable to flooding due to heavy rains, compared to households living a significant distance away from a river. In each of these two cases, local climate information would be more useful for decision making and action.

Case Study 2

COMMUNITY-MANAGED RAIN GAUGES HELP TO UNDERSTAND RAINFALL VARIABILITY

Aiming to involve users in co-generation of climate information, CARE International's Adaptation Learning Programme (ALP) in partnership with the National Meteorological Services in Niger have installed rain gauges in 30 communities in the Department of Dakoro, Maradi region.

Rain gauges form part of a community system for early warning and emergency response, commonly known as Système d'alerte précoce et de réponse aux urgences (SCAP/RU). SCAP/RUs engage a dedicated team of community members to regularly record and interpret information on vulnerability, with a focus on the food security, nutrition and health of humans and animals, on market prices, and on climate and environment.

Dela Jari, Community Early Warning Volunteer from Aman Bader village, Niger. Credit: Agnes Otzelberger/ALP 2015

Information from the community-managed rain gauges is creating a local rainfall record and is helping stakeholders in Bader Goula District of Dakoro to have a better understanding of local rainfall variability. "The data [from the rain gauges] teaches us how much the amount of rainfall differs between the different villages. Before the Early Warning and Response System was established, we only had one rain gauge here in Bader Goula. Thanks to the new rain gauges, we now know that our own rain gauge tells us nothing about the villages around. It's possible to get 60mm of rainfall here in Bader Goula and 0mm in the village just down the road…", says Issa Sokola, the local Mayor and President of the vulnerability monitoring committee in Bader Goula district.

Adapted from Integrating disaster risk reduction and adaptation to climate change, Otzelberger, 2014.

Seasonal forecasts generated by national and international meteorological services typically apply to much larger areas such as regions or entire countries. There are currently several ongoing initiatives aiming to downscale seasonal forecasts in Africa to smaller geographical areas – one of these is work being undertaken by the Kenya Meteorological Department (KMD) (see Figure 4). However, these initiatives are facing significant challenges in downscaling, such as:

1. **limited scientific knowledge on local level drivers of seasonal climate** – to deal with this challenge, the Africa Climate Research for Development (CR4D) is engaging in collaborative research linking African scientists with those from developed countries
2. **the lack of good-quality historical climate data in all geographical areas and over a sufficiently long period of time that is needed to inform downscaling processes** – this is observed particularly in rural and dryland areas in Africa, due to few and declining numbers of weather recording stations, which are also unevenly distributed (see Figure 5) (Dinku T. , Cousin, del Corral, Ceccato, & Thomson, 2016). Initiatives such as Enhancing National Climate Services (ENACTS) are working directly with National Meteorological and Hydrological Services (NMHS) to address this challenge (see Box 3).

While downscaling forecasts is a major concern, 'right scaling' the information is of even more importance. Right scaling means focusing on the climate-informed decisions that need to be made based on the context and concerns of the user, so as to provide information at the relevant scale. For example, consider a water manager in a district that is downstream of a river. The district needs rainfall forecasts:

- downscaled for their district to assess how much water would be available in the coming season. This would inform decisions such as allocation of water use across small- and large-scale irrigation, domestic and other uses.
- at a larger watershed level to cover upstream districts. This would take into account, for example, heavy rainfall that might occur in the upstream districts which could result in flooding downstream, and hence provide an opportunity for water harvesting downstream.

Figure 4: *Downscaling of the March to May 2014 seasonal forecast from national to county level, undertaken by KMD. Panel a) is the national seasonal forecast showing areas with different tercile probabilities, b) shows the expected range of rainfall amount based on the probabilistic forecast, and c) shows the downscaled forecast for Machakos County, Kenya*

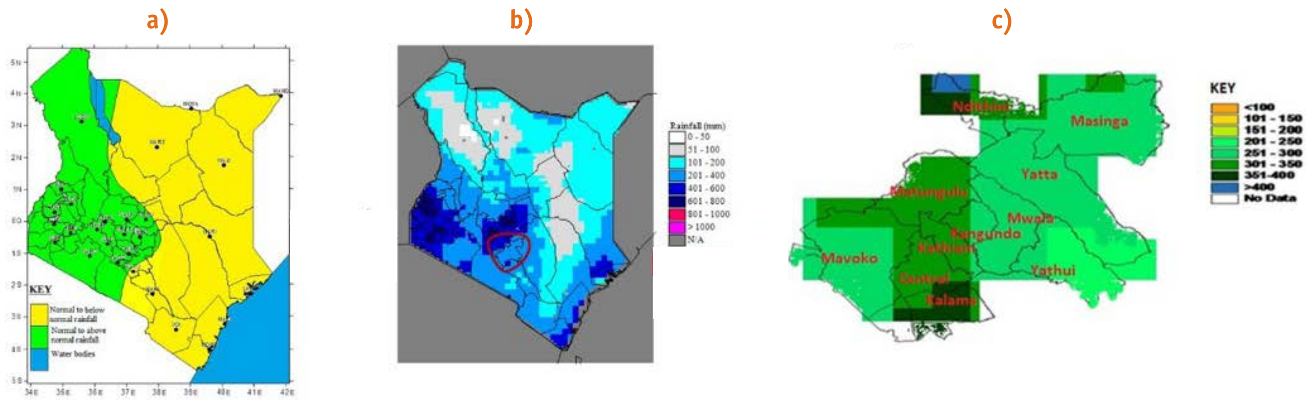
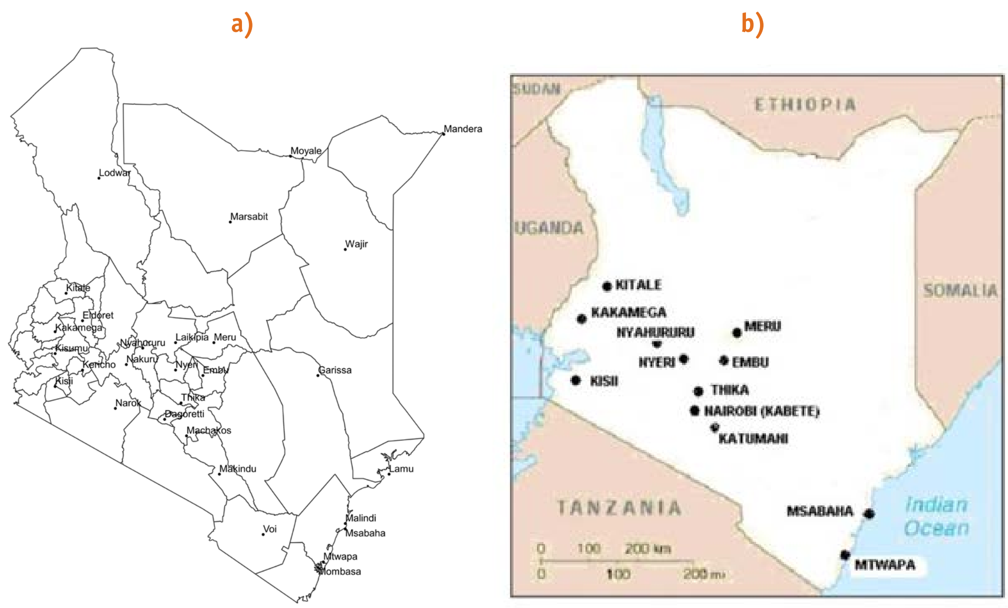


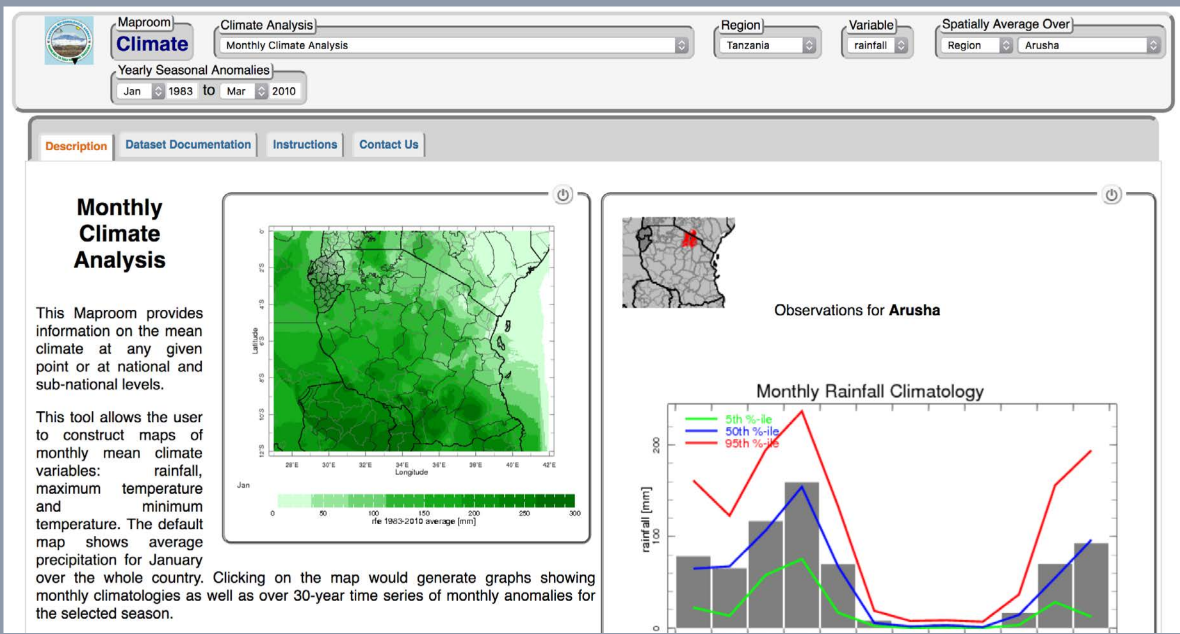
Figure 5: *Geographical distribution of a) meteorological observation stations on land and b) observation stations specialised in generating meteorological data for agriculture, in Kenya. Adapted from Kenya's National Climate Change Action Plan, Adaptation Technical Report 8: Availability and Accessibility to Climate Data for Kenya, August 2012*



Box 3
ENHANCING NATIONAL CLIMATE SERVICES

The Enhancing National Climate Services (ENACTS) initiative, led by the International Research Institute for Climate and Society (IRI) of Columbia University, is improving the availability, access to and use of climate data. This includes generating quality-controlled historical rainfall and temperature data at local, national and regional levels. Data is generated by combining climate records from national meteorological services in Africa with data from satellite and other proxies. Access to and use of this information is further improved by making information products openly and readily available through online maprooms (see Figure 6) (Dinku, Kanemba, Platzer, & Thomson, 2014).

Figure 6: *A page from the ENACTS maproom for Tanzania. Visit https://iri.columbia.edu/resources/enacts/ to access maprooms for several other countries in Africa and for two regional climate centres (ICPAC and AGRHYMET)*



Through the Weather and Climate Information Services for Africa (WISER) programme, data from ENACTS is being used in the Strengthening Climate Information Partnerships – East Africa (SCIPEA) project to test the skill of seasonal rainfall forecasting in East Africa. The work recognises that skill in seasonal forecasting is strongly related to its potential utility and economic value, and aims to improve the reliability of seasonal rainfall forecasts (Vuguziga & Owusu, 2016). Over time, this work could further improve the accuracy of downscaled seasonal forecasts.

2.2.5 Climate hazard

A climate hazard is a climate event (such as heavy rainfall) or condition (such as persistent high temperatures) with the potential to cause: loss of life; injury or other health impacts; damage and/or loss of property, infrastructure, livelihoods, service provision, ecosystems and environmental resources; or social and economic disruption ((UNISDR), 2009). Examples of climate hazards are heavy rainfall, drought and storms, as well as long-term change in climatic variables such as rises in average temperature and decreases in annual rainfall. A climate hazard tends to have an associated timeline of occurrence; it may be:

- a short-lived event – e.g. heavy rains that last a few hours
- a recurrent event with an identifiable start and end – e.g. a thunderstorm or sandstorm
- an event that occurs once in a long period of time – e.g. intense hailstorms
- slow trends such as multi-decade droughts or multi-century sea-level rise
- a more permanent change such as a transition from one climatic state to another – e.g. an area shifting from being generally hot and dry to becoming warm and wet, such as may be shown in long-term climate change projections.

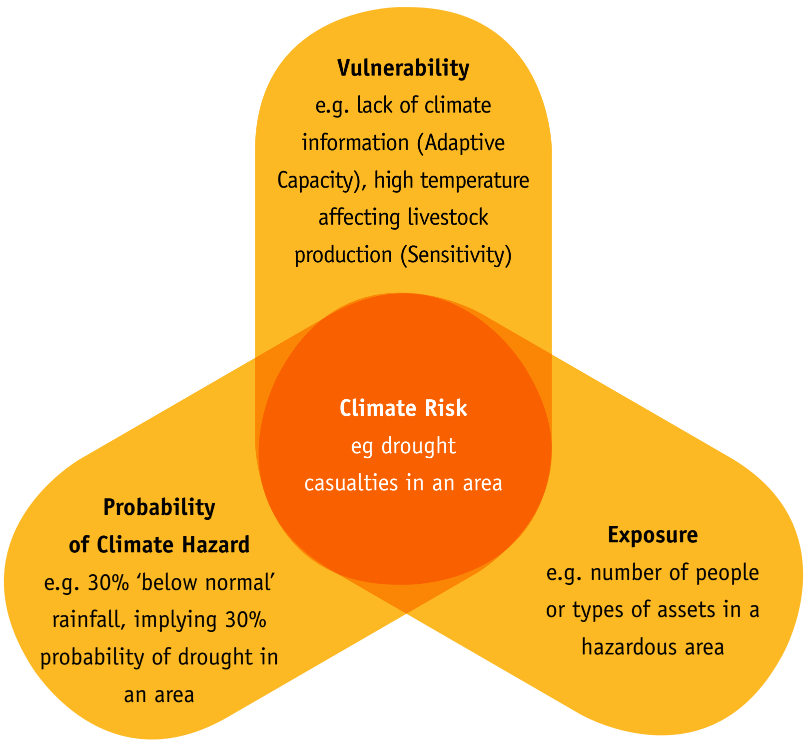
2.2.6 Climate risk

Climate risk refers to the potential for negative consequences due to climate, where something of value is at stake and where the outcome is uncertain. Due to the use of the words 'potential' and 'consequences', climate risks are represented as probability of occurrence of a climate hazard multiplied by vulnerability (of stakeholders, community, assets, environment, system, etc) and exposure to the hazard (see Figure 7).

Vulnerability refers to the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a climate hazard (UNISDR, 200 ((UNISDR), 2009); (IPCC, 2013)). As the focus is on the characteristics of the element of interest (e.g. community, system or asset), vulnerability is a combination of sensitivity to a climate hazard and adaptive capacity to manage that hazard. Further, sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g. a change in crop or livestock yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise) (IPCC, 2013).

Exposure is the presence of stakeholders, assets, livelihoods, ecosystems, environmental functions, services and resources in areas that could be adversely affected by a climate hazard.

Figure 7: *Example of climate risk due to interaction of (probability of) a climate hazard, vulnerability and exposure to the climate hazard*



It should be noted that there is not much control over the occurrence of a climate hazard but we can manage vulnerability and exposure to the hazard, which, by extension, enables management of the level of climate risk. To illustrate this, if in an area:

- probability of occurrence of a climate hazards such as heavy rainfall is 45% (or 0.45), considering a seasonal forecast
- vulnerability to the climate hazard is zero due to actions that build adaptive capacity and reduce/eliminate sensitivity – e.g. ensuring functional drainage systems, etc
- exposure to the hazard is managed to almost zero – e.g. through living some distance from a flood-prone area
- then mathematically, climate risk in the area = 0.45 x 0 x 0 = 0, meaning there is no climate risk. In reality, this is never the case as there is always some level of vulnerability and exposure, and therefore some level of climate risk in a season. This is especially true for rain-fed agricultural systems and other climate-sensitive sectors.

2.3 Opportunity in the climate context

An opportunity is potential benefit that could be gained from the occurrence of particular climatic conditions or events in a season. For example, heavy rainfall presents an opportunity for water harvesting and conservation strategies such as tapping water from the roofs or channelling floodwaters into a pan or dam to use for irrigated agriculture when it is dry. If the area is in a flood plain, receding waters provide soil moisture for cultivation of crops and pasture.

Opportunities are often linked to activities undertaken in the area by local stakeholders themselves, by government work in different sectors, and by projects and programmes run by different institutions and organisations. But for stakeholders to take advantage of possible opportunities, it is necessary to build their adaptive capacity – for example, by communicating climate information in good time and to all the actors who need it, providing technical support, improving access to financial and physical resources, etc.

members of a village savings and loans group in Garissa, Kenya. Credit: Tamara Plush/CARE 2011

2.4 Climate impacts

Climate impacts refer to positive or negative outcomes on stakeholders' lives, livelihoods, activities and strategies, resources, capacities and socio-economics caused by a combination of climate hazards, risks and opportunities. These can be potential or residual impacts.

Potential impacts are those that might occur as direct or primary outcomes of climate hazards, risks and opportunities, without considering adaptation and risk management actions taken due to a seasonal climate forecast, for example. Examples of potential impacts include:

- massive livestock mortality due to heat stress and drought, with implications for food and nutrition security, income and capital assets, businesses and economies in areas dependent on livestock

- an area receiving either high maize yields because of sufficient rainfall or loss of maize harvest due to heavy rainfall at harvest time
- movements of animals or people in search of water due to low amounts of seasonal rainfall in a particular area.

Residual impacts are those that would occur after adaptation and risk management actions have been taken by different actors through use of climate information. Examples of residual impacts include :

- functional early warning systems are informed by seasonal climate information so that there is timely provision of human and animal vaccination services to minimise the risk of waterborne diseases
- access to and understanding of climate information prompts input suppliers to stock up on specific inputs well in advance of a season or agro-processors to make provision for high inflows of agricultural produce considering highest probability of rainfall in a season being ‘above normal’
- vulnerable stakeholders living in marginal lands, who have been involved in PSP, demand government support to reduce the risk of landslides that might be triggered by torrential rain
- government, organisational and institutional plans are adjusted to provide better support for all actors to manage seasonal climate risks and opportunities.

PSP discussions often have a greater focus on potential impacts than on residual impacts. This is because bringing out residual impacts in advance of a season would mean predicting human reactions to seasonal climate information, and the interaction between these reactions, all of which are uncertain. The extensive and complex links between the different climate risk factors, uncertainties, and direct or indirect influence of actions taken by different actors in different sectors and different areas makes the multi-stakeholder forum provided by PSP workshops a crucial approach for addressing the climate challenge, through building the adaptive capacity of all stakeholders.

2.5 Advisories

Advisories are locally relevant and actionable information bulletins on options that different actors can take to manage risk, uncertainty and opportunities, based on a climate forecast. Rather than ‘instructions’ to be followed, good advisories present options for actors to consider and make their own decisions and plans for the coming season.

Some national and regional meteorological services (such as KMD, ICPAC and AGRHYMET) and programmes provide climate advisories to various users on a sustained basis. The field of agrometeorology has a long track record of delivering information and management advisories to farmers based on monitoring and forecasting at the weather timescale (Tall, Hansen, Jay, Campbell, Kinyangi, & Aggarwal, 2014). Agrometeorological advisories are often online bulletins that review the previous ten days and give an outlook of the forthcoming ten days.

The challenge is that these information advisories may be very broad, covering an entire sector or large geographical area, they may not consider the uncertainty in a forecast, or they may not be easily accessible to many users, among other challenges. And yet effective climate information and advisory services have great potential to inform decision making in the face of increasing uncertainty, to improve management of climate-related risk on livelihoods and sectors, and to help actors successfully adapt to climate variability and change (Tall, Hansen, Jay, Campbell, Kinyangi, & Aggarwal, 2014).

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